Introducing the "ChOLE" Classification and Its Comparison to the EAONO/JOS Consensus Classification for Cholesteatoma Staging

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DOI: https://doi.org/10.1097/mao.0000000000002039

Otology & Neurotology
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Introducing the ‘‘ChOLE’’ Classification and Its Comparison to the EAONO/JOS Consensus Classification for Cholesteatoma Staging

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Many previous attempts have been made to classify or categorize cholesteatomas. Recently, the European Academy of Otology and Neurotology and the Japanese Otological Society proposed a classification system based primarily on extension and complications. The European Academy of Otology and Neurotology/Japanese Otological Society consensus statement makes an effort to standardize reporting of surgical techniques. Internet-based multicenter studies are facilitated by increasing connectivity, but a mutually-agreed framework for reporting is necessary for results to be comparable across sites. New technologies compete with established standardized surgical approaches and need to be validated. It is definitively the right time to find a consensus on how to record and report surgical findings in cholesteatoma surgery. To stimulate this interesting discussion, we propose a ChOLE-classification system, which is based on the differentiation into extension (Ch), status of the ossicular chain at the end of surgery (O), complications (L), and degree of pneumatization and ventilation (E). A numeric rule is used to stage these cholesteatomas from I–III. **Key Words:** Cholesteatoma—Complications—Mastoid surgery—Middle ear surgery—Open cavity—Staging.

Otol Neurotol **40:**63–72, 2019.

Chronic otitis media with cholesteatoma formation is a frequent disease entity in otology, requiring surgery in the overwhelming majority of cases. By definition a cholesteatoma consists of skin and retention of keratin within the middle ear and/or temporal bone with surrounding inflammatory reaction and bone resorption. Histologically, it incorporates its matrix (keratinizing squamous epithelium), perimatrix (varying thickness of subepithelial connective tissue with inflammatory cells), and keratin debris. Atelectasis and retraction pockets are not considered cholesteatomas as long as they do not retain keratin debris and are not the subject of this classification. The diagnosis of a congenital middle ear or acquired temporal bone cholesteatoma is made clinically by otoscopy, and a computed tomography (CT) scan is performed to evaluate extent of disease for surgical planning. Rarely, a non-echo-planar diffusion weighted magnetic resonance imaging is ordered at the time of diagnosis to support clinical findings. A pure-tone and speech audiogram complete the workup of these patients.

The goals of surgery, which have not changed over the last seven decades, include total removal of disease and optimal hearing restoration. Complete removal is essential to minimize risk of residual pathology and prevent recurrent disease. Modern surgical approaches include open- and closed-cavities performed with or without obliteration techniques, and these approaches can be accomplished using a microscope, endoscope, or a combination of both. For hearing reconstruction, prosthetic devices are used in a primary or staged setting. At conferences and during panel discussions, otologic surgeons commonly report on ‘‘huge’’ cholesteatomas, ‘‘massive’’ extensions, and ‘‘severe’’ bony erosion.

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The authors disclose no conflicts of interest.

DOI: 10.1097/MAO.0000000000002039

However, it is difficult to compare outcomes and learn objectively from colleagues' surgical techniques if there is no uniform classification system. There have been previous attempts to classify cholesteatoma disease, but none has been widely adopted. Some have modified the TNM system used for tumors, and others have relied on anatomical barriers or classified prognostic factors (1–5).

Recently, the European Academy of Otology and Neurotology (EAONO) and the Japanese Otolgical Society (JOS) proposed a classification system based primarily on extension and complications (5). Their joint consensus was presented at the International Cholesteatoma Conference in Edinburgh in 2016. At the same congress, we presented our own ''ChOLE'' classification, which has evolved over the past several years through repeated evaluation using our 15-year prospective database of consecutive patients (6). Although ''ChOLE'' is an acronym for classifying the disease, our staging has a numeric definition calculated from the individual ChOLE scores (https://chole.surgery). We present the rationale for our classification and staging and compare it to the recently published EAONO/JOS staging and classification system.

RATIONALE FOR ChOLE CLASSIFICATION

All previous attempts to categorize cholesteatomas rely on extension. We have assigned this important element the acronym ''Ch'' for Cholesteatoma extension (Fig. 1). Extension can be described by defined anatomical spaces or by surgically challenging locations, which may require a change of approach or technique. Because the final goal is to evaluate and compare the outcome of various surgical approaches and philosophies and not necessarily to evaluate the pathogenesis of chronic otitis media with cholesteatoma formation, a surgically oriented categorization of extension is preferable. A similar concept has also been implemented in the EAONO/JOS system, which relies primarily on the middle ear space and upgrades with either ''difficult access sites'' such as the sinus tympani or protympanum and/or further extensions into the antrum and mastoid. In our Ch-class 1 the middle ear space encompasses also the epitympanic space, as most Shrapnell-cholesteatomas extend just adjacent to the incus body and/or malleus head. They can easily be removed in a transcanal fashion using a microscope or endoscope. This class Ch1 extension is further subdivided into 1a and 1b, with the latter including extension into the sinus tympani. A limited extension into the protympanum (toward the bony isthmus of the Eustachian tube) from a predominant middle ear location can still be considered Ch1.

Class 2 extensions involve the middle ear, with further extensions into the attic and antrum (2a) up to the level of the lateral canal within the mastoid. The 2b subdivision incorporates anterior extension into the anterior epitympanum (supratubal recess) with optional further extension into the protympanum and/or extension into the sinus tympani. The supratubal recess and protympanum represent an area that is difficult to reach while preserving the malleus head or chorda and is also at a difficult angle to access with straight or angulated instruments. However, current techniques allow proper removal of disease from these areas that are difficult to visualize, and therefore their involvement does not upgrade the staging in our classification system. The EAONO/JOS system also considers these spaces, which are labeled S1 for the supratubal recess and S2 for the sinus tympani. In contrast, involvement of these areas *does* increase the stage in the EAONO/JOS classification system. Both systems allow a separate analysis of this subclassification (sinus tympani or supratubal-protympanum extension) as there is currently an ongoing debate how to properly visualize and dissect these areas either endoscopically or using the microscope.

Class 3 ChOLE extension encompasses extensive bone erosion, either of the external ear canal and/or the tegmen tympani (with or without necessity of reconstruction of the defect). These cholestatomas also expand beyond the lateral semicircular canal into the mastoid and may reach the sigmoid sinus and lateral surface of the mastoid bone. The extension therefore requires an access route to the mastoid (inside out technique or mastoidectomy with canal wall preservation and reconstruction) and mandates a concept for reconstruction (with or without preservation of the remaining posterior canal wall, e.g., open cavity techniques as an alternative option). An initial subdivision into 3a and 3b was abandoned since the larger approach allows an easier access to these ''hidden'' areas.

Whereas the EAONO/JOS system does not classify apical or supra/infralabyrinthine cholestatomas, we describe these rare congenital or acquired cholesteatomas as class 4, with 4a defined as tympanomastoid cholesteatomas with infralabyrinthine, supralabyrinthine, or transcochlear extensions and 4b as apical petrous bone cholesteatomas.

In addition to extension of disease, a classification system should also highlight the status of the ossicular chain. We have appointed the acronym ''O'' to describe the status of the ossicles. The EAONO/JOS system does not account for the ossicles (5). There are two major time points when ossicular evaluation is relevant: before surgery and at the end of surgery. The state of the ossicles before surgery reflects the aggressiveness of the cholesteatoma. This is interesting when evaluating the pathogenesis or spread of cholesteatomas but does not predict outcome, as surgeons may be forced to disarticulate an intact ossicular chain for complete removal of disease. It is often difficult to visualize ossicular erosion by otoscopy or CT scan before surgery, especially the integrity of the stapes crura. A fixation of the stapes footplate by tympanosclerosis or calcification of the annular ligament is also not appreciated preoperatively but has an important impact on functional outcomes. We have therefore defined the time point to for ossicular classification as the end of surgery. ''O''-Class 0 defines an intact and mobile

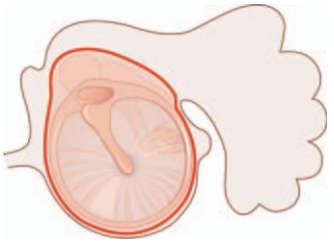
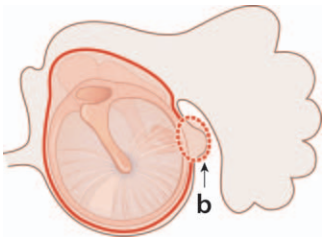
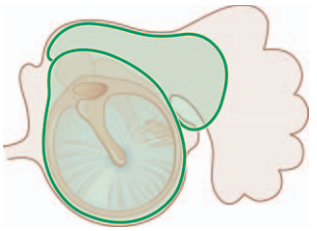
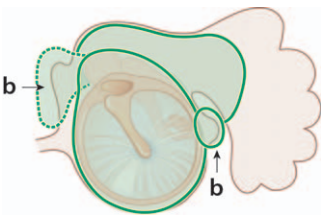
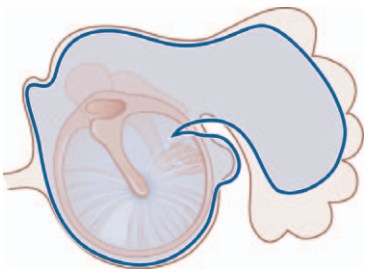
Score	Description	
1	**Middle ear space** (including Prussak's space)	
	a = no involvement of sinus tympani	
	b = involvement of sinus tympani	
2	**Middle Ear and Attic, Antrum**	
	a = attic and antrum, to the level of the lateral canal	
	b = involvement of sinus tympani and/or protympanum	
3	**Extensive Destruction**	
4	**a = Supralabyrinthine or Infralabyrinthine Extensions** **b = Petrous Apex Cholesteatoma**	

FIG. 1. Cholesteatoma extension (Ch) with corresponding scores.

ossicular chain. Class 1 reflects erosion of the long process of the incus with or without malleus head removal and represents a frequently encountered ossicular defect (Fig. 2). Class 2 involves removal or erosion of the incus and stapes suprastructure with preservation of a mobile footplate and malleus handle. Class 2 corresponds to the Austin Kartush type B or Fisch type II_1 staging of the ossicular chain (7,8).

Classes 3a and 3b refer to a mobile stapes or mobile footplate without superstructure, and classes 4a and 4b are defined as a fixed stapes or fixed footplate, respectively. The ‘‘O’’ classification is consistent with the Austin Kartush and Fisch classifications, which are already widely used. The difficulty of reconstruction increases with each higher ‘‘O’’ class and thus more ‘‘points’’ are assigned (Fig. 2).

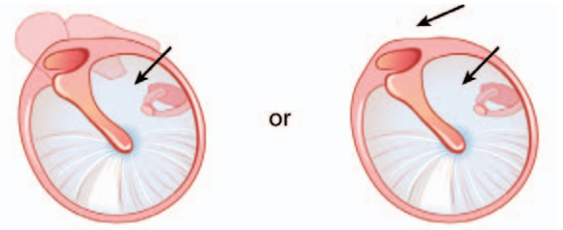
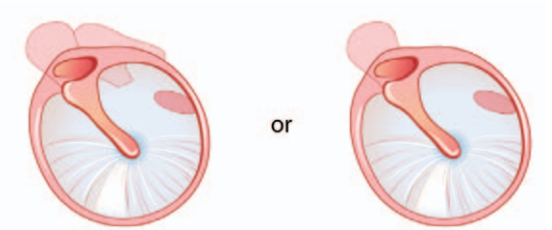
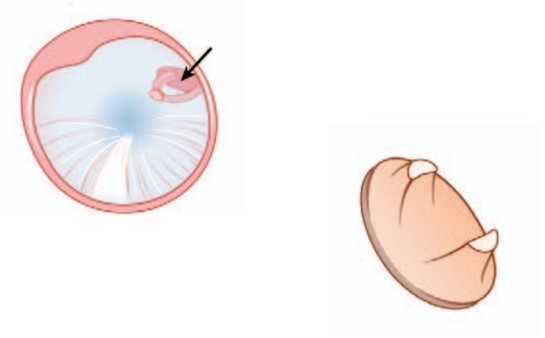
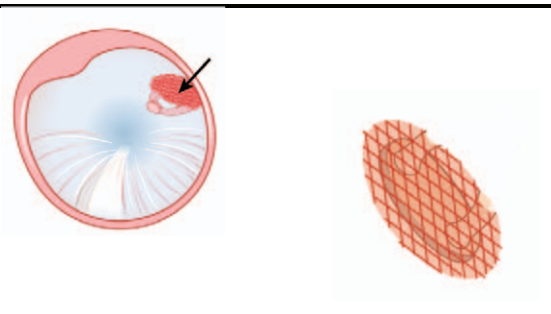
Score	Description	
0	**Ossicular Chain intact**	
1	**Malleus and Stapes present** (Incus eroded or missing) Austin-Kartush Class A Fisch I	
2	**Malleus and Footplate only** Austin-Kartush Class B Fisch II_1	
3	**Stapes only** Austin-Kartush Class C Fisch III_1 or III_4 **Mobile Footplate only** Austin-Kartush Class D Fisch III_2 or III_5	
4	**Fixed Stapes only** Austin-Kartush Class F Fisch III_3 or III_6 **Fixed Footplate only** Fisch III_3 or III_6	

FIG. 2. Postoperative ossicular chain status (O) with corresponding scores.

Complications due to cholesteatoma may require alteration of the surgical plan. Depending on the severity and time course of the complication, hearing reconstruction may no longer be the major goal of the surgery, and limited exposure will likely not be adequate. The EAONO/JOS classification system also considers extracranial and intracranial complications. We have appointed the acronym ''L'' of the ChOLE classification for ''life threatening complications.'' Extra- and intracranial complications are highlighted using the ''i'' information button adjacent to either the drawing or the text (Table 1). Extracranial complications are rated with two points and intracranial lesions with four points. While the EAONO/JOS system is quite similar, our system rates ''brain herniation'' under extracranial complication labeled as ''tegmen defect requiring surgical repair.'' Our rational is that major defects of the tegmen may lead to a meningocele (without brain herniation) or a meningoencephalocele. Major lesions are addressed surgically by repositioning and repair of the defect. A minor prolapse of the dura may not even require a full reconstruction of the tegmen defect, only low current coagulation of the intact dura. These minor lesions are not classified as complications of the cholesteatoma.

The EAONO/JOS system stages all cholesteatomas irrespective of their anatomical extensions into stage III in case of extracranial complications and stage IV in any case of intracranial complication, including brain herniation. The ChOLE staging is a numeric grading and does not automatically lead to a higher stage in case of a complication (see below).

The acronym ''E'' corresponds to the rating of ''Eustachian Tube function.'' The degree of pneumatization of the mastoid is considered an indirect sign of Eustachian tube function and gas exchange through the mucosa during the first years of life. Early middle ear infections, otitis prone conditions, and recurrent OME do not allow wide pneumatization of the temporal bone within the first 4 to 6 years of skull growth during childhood. Most acquired cholesteatomas therefore present with some degree of sclerosis within the mastoid (9).

Aereation at the time of the CT scan can be assessed by evaluating the ventilated ''black'' areas of pneumatized cells compared with opacification, which can represent fluid accumulation and granulation tissue, thickened mucosa, or cholesterol granulomas. Previous classification systems, including the EAONO/JOS, do not consider the degree of mastoid pneumatization and ventilation. We include it in our classification system due to its impact on surgical approach and choice of technique. Previously, a sclerotic mastoid most often required an open technique, whereas a sufficiently wide and ventilated mastoid led to a combined approach. Recently, mastoid obliteration techniques using different materials have become more and more popular. However, it remains unclear which types of mastoids should be left open and aerated through the attic or closed and tightly obliterated. Endoscopic techniques try to remove the cholesteatoma and preserve as much mucosa as possible, both in the middle ear and mastoid. Long-term outcomes are still lacking and may depend on the ventilation properties of the middle ear. Initially, we had five different entities to rate the pneumatization and ventilation. However, the interobserver reliability was poor, so we simplified the classification to three stages. ''E'' class 1 describes a moderate to good pneumatization of the mastoid with more than 50% of cells aerated, whereas class 2 is defined as moderate to good pneumatization but poor ventilation, with more than 50% of the cells opacified. Class 3 represents a sclerotic mastoid that may have some ventilation in the attic but no cells in the remaining mastoid or mastoid tip. As most patients do get a CT scan during their workup for further treatment planning, this distinction can be made using CT scan analysis. If no scan is available, surgeons may stage the pneumatization and ventilation during mastoid surgery as well.

In summary, the ChOLE classification system facilitates rating of cholesteatoma extension, ossicular chain status at the end of surgery, identification of complications, and pneumatization and ventilation. If one or more of these items cannot be classified (retrospectively), it is

TABLE 1. *Comparison of extracranial and intracranial complications between the EAONO/JOS and ChOLE classification systems*

EAONO/JOS	ChOLE
Extracranial complications (Stage III)	Extracranial complications assigned two points
Facial palsy	Facial palsy
Labyrinthine fistula: with conditions at risk of membranous labyrinth	Labyrinthine fistula (not prefistula)
Labyrinthitis	Labyrinthitis
Postauricular abscess or fistula	Mastoditis or Mastoid fistula
Zygomatic abscess	Bezold's or Luc's abscess
Neck abscess	Tegmen defect requiring surgical repair
Intracranial Complications	Intracranial Complications
Stage IV	Assigned 4 points
Purulent meningitis	Meningitis
Epidural abscess	Brain (extra- or intradural) abscess
Subdural abscess	Seizures
Brain abscess	Sigmoid sinus thrombosis
Sinus thrombosis	
Brain herniation into the mastoid cavity	

marked as ''not identifiable (not specified) '' and this item receives the affix ''x.''

RATIONALE FOR ChOLE STAGING

The ChOLE classification system allows comparison of similar types of cholesteatoma extensions (Ch 1–4) and evaluation of audiometric outcomes of the same postoperative ossicular chain status (O 1–4 a,b), facilitating direct comparison of different reconstruction techniques. The ChOLE classification system also delineates patients with severe intra- and/or extracranial complications and supports prospective evaluation of outcomes (e.g., recidivism, hearing, extrusion rates of prosthesis) in relation to preoperative mastoid ventilation. To simplify the classification of large numbers of patients, most previous systems have adopted a summarized staging system for each patient. The EAONO/JOS system is intended to reflect the severity of the cholesteatoma, the difficulty to achieve complete removal, and the subsequent restoration of normal function. Stages 1 and 2 are based extension: if more than one site is involved, the patient is staged as stage 2. Stage 3 represents extracranial complications and stage 4 intracranial complications. In contrast, each element of the ChOLE classification system is numerically rated. Stage I is defined as 1 to 3 points, Stage II as 4 to 8 points, and Stage III as all values above 8 (Table 2). The corresponding numbers are listed in the left column of Figure 3.

EVALUATION OF THE ChOLE CLASSIFICATION AND STAGING SYSTEM AND ITS CLINICAL APPLICATION

Over the last 2 years we have tested our classification system multiple times in a retrospective cohort of 100 primary cholesteatoma cases, subdividing this group into a random sample of 40 and 24 cases. These investigations were approved by the local Ethics committee (Nr. 11,063). We have also prospectively classified all primary or revision cases with five surgeons involved in chronic middle ear surgeries. We used our prospective ENT-Statistics database (Innoforce ENT statistics, www.innoforce.com), where standardized coding, scanning of the surgeon's drawing, audiograms, CT and magnetic resonance imaging scans are entered for each patient at the end of surgery by the otologist. Every 4 months we re-evaluated the current version and fixed discrepancies, tested interobserver reliabilities, and improved our classification and staging system. An online tool was generated to be used on any computer for easy and straightforward application of the ChOLE system (https://chole.surgery). The following improvements were implemented to the current version.

Cholesteatoma Extension

Initially, it was the surgeon's choice to use a blank paper for his surgical drawing of cholesteatoma extension in addition to the checklist provided by the ENT statistics database. However out of 40 patients there was unacceptable disagreement between different observers in our retrospective analysis of these cases due to poor quality of the drawings or inconsistencies between the drawing and the checklist or the operating report. We have therefore required our surgeons to use a preformed template with a consistent color code (cholestatoma in blue, ossicles in back pencil) before they rate the extension on the ChOLE app. Retrospectively, a further analysis of 24 patients showed over 90% agreement between 4 different observers. The reliability on a checklist-only system for retrospective reviews was unsatisfactory, since written OR reports did not allow accurate identification of the proper extension in the majority of cases. Instead, a standardized schematic template indicating the anatomical borders and supported with ''info'' buttons explaining questionable extensions was strongly preferred. In a retrospective analysis of 100 primary middle ear and mastoid cholesteatomas by 2 observers, a class Ch3 was only encountered in 2 instances, whereas classes 1and 2 were almost evenly distributed. In a further analysis of 24 randomly selected cases by 3 observers, 65% scores were class Ch1, 30% class Ch2, and 5% Ch3.

Ossicular Chain Status

Since the postoperative status of middle ear ossicles was rated according to the well-known Austin-Kartoush and Fisch Scores and clearly defined, there was almost full agreement between four different observers. Out of

TABLE 2. *Staging*

EAONO/JOS	ChOLE
Staging systems for respective cholesteatoma types	
1) Pars flaccida cholesteatoma (attic cholesteatoma)	
Stage I: localized in the attic	Stage I: sum of classification values between 1 and 3
Stage II: Cholesteatoma involving two or more sites	
Stage III: Cholesteatoma with extracranial complications	Stage II: sum of classification values between 4 and 8
Stage IV: Cholesteatoma with intracranial complications	
	Stage III: sum of classification values over 8
2) Pars tensa and congenital cholesteatoma	
Stage I: localized in the tympanic cavity	
Stage II: Cholesteatoma involving two or more sites	
Stage III: Cholesteatoma with extracranial complications	
Stage IV: Cholesteatoma with intracranial complications	

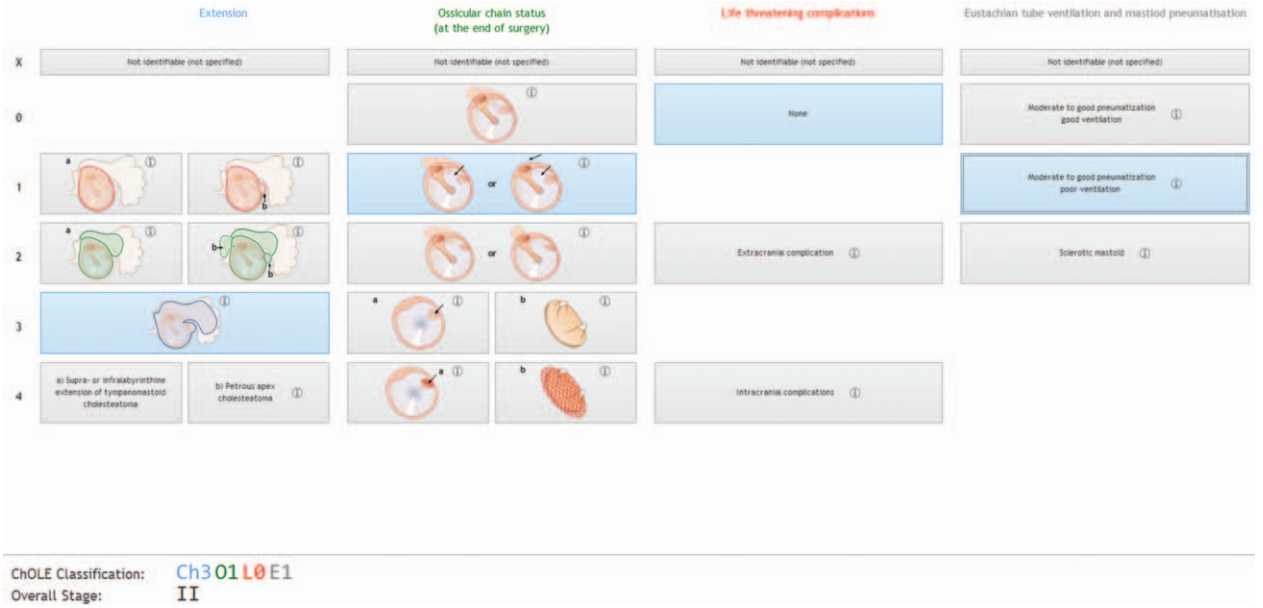


FIG. 3. Summary of ChOLE classification and staging. An example of extensive extension (Ch3) with incus erosion (O1), no complications (L0), and moderate pneumatization with poor ventilation (E1) is highlighted in blue, the overall stage calculated as II (five points). This figure is available online at www.chole.surgery.

100 cases, 25% were scored as an intact chain, 50% had an erosion of the incus, 12% had an intact stapes, and 12% showed an absent suprastructure with mobile footplate. A fixed footplate was encountered in only one case. Out of the 24 random cases, the distribution was very similar. When comparing the preoperative audiograms of 100 patients from our database using the ''O'' score, we found a considerably worse preoperative PTA (0.5–4 kHz) with increasing class of the ''O'' score. In a yet unpublished analysis of over 300 cholesteatoma cases, we calculated that a preoperative air-bone gap at 500 Hz and 4 kHz of more than 23 dB had a sensitivity to predict an eroded stapes suprastructure of 80% and specificity of 60%. These examples highlight why we strongly advocate use of ossicular chain classification in any cholesteatoma staging system to analyze audiogram patterns both pre- and postoperatively.

Complications

Severe complications from cholesteatomas have become quite rare in countries with far advanced health care systems. This is also reflected by the distribution of extension in our case series. Out of 100 patients we did not find a single severe complication, and within the group of 24 cases, only 1 patient with a brain abscess and staged surgeries for his cholesteatoma was identified as L4. It is important to note that frequently encountered circumstances such as a dehiscent facial nerve, lateral canal prefistulas (blue lining), or a defect of the tegmen with exposed dura that does not require repair are not coded as complications in our system. These sequelae of cholesteatomas do not necessarily change the surgical approach or functional outcome. They may still be recorded on a checklist-based system labeling intraoperative findings. However, we favor classifying intra- or extratemporal complications that necessitate a change in surgical plan, e.g., emergency drainage of an abscess before complete resection of the lesion, reconstruction of a tegmen defect, or a subtotal petrosectomy. In low resource settings, such complications arising from cholesteatomas are more prevalent (10). A rather small cholesteatoma limited to the middle ear (Ch1) may rarely induce a facial palsy due to a dehiscent tympanic segment of the facial nerve (L2) and the final numeric stage may still remain stage 1. We have encountered this situation only once within 17 years in a recurrent cholesteatoma case. Nevertheless, the final stage calculation adding values from the four elements may by its value not necessarily reflect the severity of a complication.

Ventilation and Pneumatization

Many attempts have been made to categorize the ventilation properties of the mastoid (11,12). Initially we distinguished five different categories, however the interobserver reliability was poor. Except from congenital middle ear or apical cholesteatomas and iatrogenic cholesteatomas, most acquired cholesteatomas evolve from previous recurrent acute or chronic otitis media and present with reduced pneumatization. We therefore distinguished moderate-good pneumatization and ventilation (class 1) from poor ventilation (class 2) and sclerotic mastoids (class 3). Analyzing preoperative CT scans from a random sample of 19 primary cholesteatomas between 15 different observers with a range of otological experience, all observers were able to distinguish between class 1 and worse categories (either 2 or

TABLE 3. *Example of a small series of 24 patients focusing on recidivism (recurrent and residual cholesteatomas) and its correlation to cholesteatoma extension, pneumatization, and surgical approach*

n = 24	Total		Closed MET n = 14		Open MET n = 6		Endoscopic n = 4		Recidivism	
Ch 1	15	62%	10	66%	2	13%	3	20%	3	20%
Ch 2	7	30%	4	57%	2	29%	1	14%	1	14%
Ch 3	2	8%	–	–	2	100%	–	–	–	–
E 0	–	–	–		–		–		–	
E 1	7	30%	4	57%	1	14%	2	29%	2	29%
E 2	17	70%	10	59%	5	29%	2	12%	2	12%
Recidivism	4	16%	3/14	21%	0	0%	1/4	25%		
Stage I	10	42%	5	50%	1	10%	4	40%	2	20%
Stage II	13	54%	9	70%	4	30%	0		2	15%
Stage III[a]	1	4%	–		1	100%	–		0	

Data could also be presented adding the ossicular chain status.
[a]One patient had a facial palsy (HB II) due to the cholesteatoma (Ch3b O3b L1 E2).

3). However, for patients with poor pneumatization, observers seemed to find the choice between class 2 or 3 more challenging. Indeed, in some patients there was an almost 50:50 division between class 2 and 3 that was independent of otologic experience. The interclass correlation coefficient for all raters and cases was 0.657 (>0.6 indicates good consistency and >0.75 is considered excellent). From a purely statistical point of view, we should prefer a two-stage score. However, as clinicians the impact of mastoid pneumatization on surgical planning is quite considerable. The current dispute between endoscopic and microsocopic approaches and obliteration versus open techniques warrant subdivision between moderately well pneumatized, poorly ventilated, and predominantly sclerotic mastoids. All three classes of pneumatization/ventilation do not add significant point values (0, 1, 2) to the overall score, e.g., a sclerotic mastoid is rated with the highest score of two points.

HOW TO PRESENT DATA USING THE ChOLE CLASSIFICATION AND STAGING SYSTEM

There are many ways to use and summarize the ChOLE classification and staging system in a systematic and transparent way. As an example, we have selected randomly a small subset of 24 cases of primary cholesteatomas and address the issue of ''type of surgery'' and ''recidivism'' using the extent rating (Ch1-3), degree of pneumatization and ventilation, and the staging for this patient population (Table 3). The reader easily recognizes what types of cholesteatomas were operated with a closed or open technique and which approach leads to higher rates of recidivism. Table 4 summarizes the impact of the ossicular chain and the type ossiculoplasty on hearing outcome in open and closed cavity settings. Here, any additional values can be added (e.g., individual frequencies, bone conduction, speech discrimination), as well as various types of reconstruction used for each

TABLE 4. *Pre- and postoperative hearing and its correlation to ossicular chain status, type of ossiculoplasty, and surgical approach in a series of 24 patients*

n = 24	Total		Preop. PTA ABG (0.5–3 kHz) dB	Postop. PTA ABG (0.5–3 kHz) dB	ABG Improvement (0.5–3 kHz) dB	Postop. PTA ABG < 20 dB
Closed MET	14	58%	24.1 (±14.3)	18.2 (± 10.2)	5.9 (± 9.6)	76%
O_0	2	14%	12.6 (±5.8)	11.1 (±5.9)	1.5 (±2.8)	100%
O_1 Incus interposition	11	78%	23.3 (±14.2)	17.6 (±9.8)	5.7 (±10.1)	81%
O_2 TORP	1	8%	30.3	21.6	8.7	0%
O_3	0		–	–	–	–
Endoscopic	4	17%	12.0 (±4.2)	11.2 (±6.5)	0.8 (±3.2)	100%
O_0	4	100%	12.0 (±4.2)	11.2 (±6.5)	0.8 (±3.2)	100%
Open MET	6	25%	30.6 (±18.2)	22.4 (±16.5)	8.2 (±12.7)	66%
O_0	0		–	–	–	–
O_1Incus interposition	2	33%	26.2 (±9.2)	16.0 (±2.1)	10.2 (±6.4)	100%
O_2 TORP	1	16%	40.6	23.4	17.2	0%
O_3 Type III	3	50%	27.4 (±7.2)	20.9 (±9.2)	6.5 (±7.6)	66%

ossicular chain status. This sort of tabulation clearly separates ''apples from oranges'' and allows a more detailed description of the actual findings. Various statistical analyses of different reconstruction techniques seem easier to understand, and final outcome is not just presented as ''75% of all closed MET surgeries achieve an ABG of less than 20 dB'' which is frequently stated in the literature. If one only reports on a subset of cholesteatoma patients with a patient's own incus interposition, e.g., Ossicle category O_1 the table will include Ch Extension and Pneumatization properties. This will also help to elucidate differences between open, closed, endoscopic, or mastoid obliteration techniques in relation to the final hearing outcome.

COMPARISON OF ChOLE CLASSIFICATION/ STAGING AND EAONO/JOS STAGING SYSTEMS FOR MIDDLE EAR CHOLESTEATOMAS (EXCLUDING PETROUS BONE AND APICAL LESIONS)

Although the anatomical compartments are similar, there are three main differences between the two grading systems. 1) The EAONO/JOS system simplifies extension into four sites. The tympanic cavity ends at the level of the annulus or shrapnel space. The attic as a second site includes small extensions into Prussak's space, as well as full extension to the middle fossa dura in the attic and epitympanum. The ChOLE system differentiates between a limited Prussak's space involvement (Ch1) and further attic involvement with optional extension into the aditus ad antrum and along the middle fossa dura (Ch2). This differentiation was made because limited epitympanic extensions do not require extensive bone removal for dissection of the cholesteatoma matrix, but further extension may require a combined transcanal-transmastoid approach or an inside-out technique with external ear canal dissection and reconstruction. Therefore, early pars flaccida cholesteatomas with limited extensions toward the tympanic cavity or early pars tensa cholesteatomas extending toward Prussak's space are both considered stage II in the EAONO/JOS system but are stage Ch1 in our ChOLE system. 2) Extensions into the sinus tympani and toward the protympanum are identified in both systems. Within the EAONO/JOS grading system, a higher score is attributed and therefore this rather limited overall extension is upgraded because two sites are involved. 3) The final stage in our system is calculated by adding values from the four Ch, O, L, and E classification numbers, and the total points fall into three stages. The EAONO/JOS system stages according to extension for stages I and II and according to the complications for stages III and IV. Categorizing various numbers of primary cases in our prospective series revealed that over 85% of cases were classified as stage II in the EAONO/JOS system, with only one patient falling in stage IV (intracranial abscess). Disagreement between the ChOLE and EAONO/JOS staging occurred in 25% of cases, predominantly between ChOLE stage I and EAONO stage II.

The EAONO/JOS definitions and classification have been criticized by Merkus et al. (13) mainly for their anatomical borders and the negligence of the ossicular chain status. They proposed a more accurate definition of the attic and epitympanic space and took into account anatomical bony borders visible on preoperative CT scans. Their final staging is based on the number of involved sites with STAM1CO as one site and STAM3CO as three or more locations or involvement of one or more difficult to reach access sites (S1 = anterior epitymanum and S2 = sinus tympani). Saleh and Mills (14) in his classification system identified seven sites of possible extension and staged five different locations starting with a single site (S1) and ending at S5 for cases with a primary site and affection of another four or more sites. Both authors also suggest incorporating the ossicular chain status with a similar subdivision from O0 or On as an intact chain and ending at O3 with three ossicles missing. However, Merkus et al. recommend staging the ossicular chain at the beginning of the surgery. We favor to classify the ossicular chain status at the end of surgery, as the surgeon may decide to disconnect or remove parts of the ossicular chain and the final audiological result will depend on the postoperative status. The Japanese Otological Society had started in 2004 to implement a strict nomenclature and classification system, which was modified over the years and finally joined with the EAONO group. Early on they also considered the importance of the mastoid pneumatization and the status of the ossicular chain but further subdivided into pars flaccida and pars tensa retraction pocket cholesteatomas (15). The final EAONO/JOS classification abandoned the value of mastoid pneumatization and ossicular chain status.

SUMMARY

We appreciate the clinical classification of middle ear cholesteatomas by the European and Japanese societies in respect to the initial differentiation between congenital, acquired retraction pocket and nonretraction pocket cholesteatomas. However, we disagree with the classification and final staging of these cholesteatomas. We propose classification by extension (Ch), status of the ossicular chain at the end of surgery (O), complications (L), and degree of pneumatization and ventilation (E), with a numeric rule to stage these cholesteatomas from I–III. There is abundant work being done to categorize and standardize surgical techniques for cholesteatoma removal and ossicular chain reconstruction, both by using endoscopes and/or microscopes. Comparison of surgical outcomes across techniques is only possible if the baseline of disease is also categorized. Adoption of the ChOLE classification system for cholesteatoma reporting will facilitate these important discussions.

Acknowledgments: The authors acknowledge the help of Dr. Katja Dalkowski for illustrations (kdalkowski@online.de).

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